PATENT
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METHOD FOR REMOVING LAYERS OF HARD MATERIAL

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation application of International Application PCT/CH99/00234, filed May 31, 1999 and claims priority on Swiss patent applications 1269/98 filed June 11, 1998 and 1404/98 filed July 1, 1998.

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a method for removing layers of hard material, except TiN, from hard metal substrates.

Definition

For the purpose of this disclosure, "hard material layer" means a layer comprising an oxide, nitride, carbide, carbonitride or carboxynitride of at least one element of groups 4, 5, 6, 13, 14 according to the "New IUPAC Notation", for example according to the "CRC Handbook of Chemistry and Physics", CRC Press, 77th Edition, "Periodic Table of Elements", wherein the hard material layers comprising the above listed materials are poorly soluble in solutions comprising H_2O_2. TiN is excluded from these hard material materials.

German Patent DE 43 39 502 discloses removing, as hard material layers, duplex layers comprising TiN/TiAlN from hard metal substrates by means of complexly composed solutions based on hydrogen peroxide.

The solution applied according to DE 43 39 502 for the layer removal of TiN/TiAlN duplex hard material layers satisfies the requirements for short layer removal times and for the capacity for being carried out only slightly above ambient temperature. But, due to its complex composition, it does not satisfy the requirement for simple [waste] disposal. In addition, the solutions used, which indiscriminately dissolve the TiN and TiAlN layers, lead to an unacceptable degradation of the hard metal substrate surface. The solutions employed are expensive.

SUMMARY OF THE INVENTION

It is the task of the present invention to remedy the above disadvantages and to propose a layer removal method for hard material layers which, on the one hand, retains the advantages of the method known from DE 43 39 502, namely with respect to short layer removal times and layer removal temperature, but, in addition, degrades the hard metal substrate surface far less, is simple in the solution composition and can be readily disposed.

This is attained according to the invention by applying, between the substrate and the hard material layer, a TiN intermediate carrier layer and wherein the hard material layer is removed by selectively dissolving predominantly only the TiN layer, namely through pores of the hard material layer. This also explains why the method according to the invention is not intended for TiN hard material layers themselves, even if this method can be employed quite reasonably in order to remove layers from workpieces with hard material layers of the above type and

simultaneously, or basically in the same bath, remove layers from TiN-coated workpieces.

According to the invention it was found that, if the intent is not directed toward the purpose of dissolving the hard material layer itself but toward providing between hard metal substrate and hard material layer an intermediate carrier layer, which can be dissolved substantially more simply than the hard material layer per se, because of the porosity which is always present, in particular, in PVD-applied hard material layers, leads to the undermining of this layer and the dissolving of the intermediate carrier layer. This leads to the fact that the hard material layer, which is not at all, or substantially less, dissolved, falls off.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its uses, reference is made to the accompanying descriptive matter in which a preferred embodiment of the invention is illustrated.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In a preferred embodiment of the method, hard material layers are removed which comprise a layer of type

$$(E_1, E_2 \ldots E_n)\ X$$

wherein

E_x: is an element No. n = x from one of the groups 4, 5, 6, 13, 14 according to the New IUPAC

Notation of the Periodic Table of Elements, where

X: is at least one element of the group containing N, C, O; and

n: is a running parameter, with $n \geq 2$, in particular with $n = 2$.

The thickness of the intermediate layer is substantially less than that of the functional hard material layer. The intermediate layer thickness d_z is preferably selected as follows:

$$0.01\ \mu m \leq d_z \leq 0.5\ \mu m,$$

preferably $0.01\ \mu m \leq d_z \leq 0.3\ \mu m,$

especially preferred $0.01\ \mu m \leq d_z \leq 0.2\ \mu m.$

In a further preferred embodiment of the method according to the invention the elements E_x - with $1 \leq x \leq n$ - comprise Al and/or Si and/or Cr and/or boron. In a further preferred embodiment of the method according to the invention the hard material layer comprises a CrC, CrN, CrCN or a WC-C layer.

In a further preferred embodiment of the method according to the invention the hard material layer comprises a TiAlN and/or TiCrN layer, wherein in an especially preferred embodiment the hard material layer comprises a TiAlN layer, therein, in particular preferred,

is a TiAlN layer.

The hard material layer preferably has a layer thickness of at least 2 μm.

As the solution is preferably used a hydrogen peroxide solution, therein preferably with maximally 50 wt.% hydrogen peroxide, in particular preferred with maximally 20 wt.% hydrogen peroxide. To this solution further is preferably added NaOH, this preferably at maximally 5 wt.%, in particular preferred maximally 0.5 wt.%.

Further, to the solution is therein preferably added at least one of the substances disodium oxalate, KNa tartrate tetrahydrate, preferably maximally 5 wt.%, in particular preferred maximally 0.5 wt.%. In an especially preferred embodiment, the solution employed comprises, in addition to water, exclusively hydrogen peroxide, preferably at the stated percentages by weight, as well as NaOH, also preferred at the stated percentages by weight, as well as at least one of the listed substances disodium oxalate, KNa tartrate tetrahydrate, also preferably in the stated concentration.

Examples:

Hard metal indexable inserts were coated with a layer packet TiN/TiAlN. The TiN intermediate layer had a thickness of 0.5 μm, the total thickness of the packet was 4 μm.

Variant 1:

In a solution:

- H_2O_2 : 17.5 wt.%
- disodium oxalate : 2.5 wt.%

- NaOH : 0.25 wt.%

the start of the layer removal could already be observed at 50 °C 10 minutes after the coated substrates were placed into the solution. Hard material layer pieces of a size up to 30 mm^2 became detached. After two hours the layers were completely removed from the substrates without any degradation of the surface of the hard metal substrate having occurred.

Variant 2:

Layers were removed from the above discussed coated hard metal indexable inserts at 30 °C in a solution:

- H_2O_2 : 17.5 wt.%
- KNa tartrate tetrahydrate : 2.5 wt.%
- NaOH : 0.1 wt.%.

Again, the start of the layer removal process could already be observed 10 minutes. Detached hard material layer pieces are clearly visible in the layer-removal solution. After 2 hours, the layers had been removed from the indexable inserts without any degradation of the hard metal substrate surface.

It is evident, that the method according to the invention already has an extremely satisfactory effect at relatively low detachment temperatures, at temperatures, for example, in the range from 20 °C to 60 °C.

While specific embodiments of the invention have been shown and described in detail to illustrate the application

of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.